BACKGROUNDER

Dietary Fats & Fat Replacers

chapter 6

Dietary fats are nutrients needed for an overall healthful lifestyle.

Dietary fats are nutrients needed for an overall healthful lifestyle. Like carbohydrates and protein, dietary fats are an important source of energy for the body. Fats are the most concentrated source of energy in the diet, providing nine calories per gram compared with four calories per gram from either carbohydrates or protein.

Dietary fats supply essential fatty acids, linoleic and linolenic acids, which are especially important to children for proper growth. In addition, fats are required for maintenance of healthy skin, for regulation of cholesterol metabolism, and as a precursor of prostaglandins, hormone-like substances that regulate many bodily functions. They are also needed to carry and aid in the absorption of fat-soluble vitamins A, D, E, and K and carotenoids. In some cases, dietary fats supply the vitamin too—for example, the major source of vitamin E in the diet is soybean oil.

The largest amount of fat is stored in the body's adipose (fat) cells but, some fat is found in blood plasma and other body cells. These fat deposits not only store energy, but also are important in insulating the body and supporting and cushioning organs.

Physical and Functional Properties of Dietary Fats and Cholesterol

Fats are composed of the same three elements as carbohydrates: namely carbon, hydrogen, and oxygen. However, fats have relatively more carbon and hydrogen and less oxygen, thus accounting for the higher energy value of nine calories per gram.

Technically, fats should be referred to in the plural, as there is no one type of fat. Fats are actually combinations of many different fatty acids that exert characteristic physiological and metabolic effects in the body. Saturated and unsaturated fats are designated by the presence of double bonds within the chain of carbon atoms in the fatty acid. Saturated fats have no double bonds, whereas unsaturated fats have double bonds. Unsaturated fats with one double bond are called monounsaturated fatty acids (MUFAs) and those with more than one double bond are called polyunsaturated fatty acids (PUFAs) (See Chart). In general, fats containing a majority of saturated fatty acids are solid at room temperature, although some solid vegetable shortenings are up to 75 percent unsaturated. Fats containing mostly unsaturated fatty acids are usually liquid at room temperature and are called oils. Saturated fatty acids are more stable than unsaturated fatty acids because of their chemical structure. Stability is especially important in cooking oil and food products containing oils/fats as ingredients to maintain flavor, cooking performance, and to prevent rancidity.

Polyunsaturated fats are further distinguished by the position of the double bonds in their structure. Designated by "omega" (e.g., omega-3, omega-6), this term indicates the position of the beginning of the first double bond starting from the methyl end of the fatty acid. Two examples

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Brochures

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Fats in the Diet

Fish & Your Health

Food Ingredients & Colors

Weight Loss: Finding a Program That Works for You

Your Personal Path to Health: Steps to a Healthier You!

IFIC Reviews

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Sorting Out the Facts About Fat

Uses and Nutritional Impact of Fat Reduction Ingredients

Q&As

http://ific.org/publications/qa

Questions and Answers About Dietary Reference Intakes

Questions and Answers About Fat Replacers

Questions and Answers About *Trans* Fats

Questions and Answers About the 2005 Dietary Guidelines

Food Insight Articles

http://ific.org/foodinsight

The Dietary Guidance Gap: Consumers Know They are Supposed to Do Something —But are Fuzzy on the Details May/June 2006

Consumer Testing of Dietary Guidance Tools around the World: An International Overview May/June 2006

Food Science: The Bridge between Health and Consumer Taste Preferences March/April 2006

Robert E. Brackett, PhD: An Interview with FDA's Director of the Center for Food Safety and Applied Nutrition March/April 2006

Make the Most Out of Dietary Fats Information: Keep the *Trans* AND Saturated Fats Down Jan./Feb. 2006

Keeping Up with the Changing Food Label Jan./Feb. 2006

Translating the Facts about *Trans* Fat

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March/April 2005

Insights on Traditional (Tried and True) Dietary Fat Consumption Jan./Feb. 2005

Communicating the Dietary Guidelines for Americans, 2005: Lessons Learned from Consumer Research Jan./Feb. 2005

The Myth of Zero: The Elusive Goals of Absolute Safety and Guaranteed Benefits Nov./Dec. 2004

Research

http://ific.org/research

Food & Health Survey: Consumer Attitudes toward Food, Nutrition & Health

Food Label & Calorie Research: Qualitative Research Findings

Exploratory Research To Understand Consumer Receptivity To The Concept of Energy Balance

Fitting Dietary Fats into a Healthful Diet--A Consumer Point of View

Exploring Consumer Attitudes Regarding Portion Management and Dietary Fat

Impact of Trans Fat Label Information on Consumer Food Choices

Other Resources

It's All About You
http://www.ific.org/publications/other/allaboutyouom.cfm

Tools for Effective Communications
http://ific.org/tools/intro.cfm

United States Department of Health and Human Services (DHHS)
Dietary Guidelines for Americans 2005
http://www.healthierus.gov/dietaryguidelines/

United States Department of Agriculture (USDA)
MyPyramid.gov Food Guidance System
http://MyPyramid.gov

Access additional **RESOURCES** and **UPDATES** on related topics at:
http://ific.org/nutrition/fats

of omega-3 fatty acids include eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA). Oily fish from cold waters, such as salmon, mackerel, tuna, and trout are especially rich in EPA and DHA. (For a list of common saturated and unsaturated fatty acids, see Chart).

Systematic Name	Common Name	Typical Fat Source
Common Saturated Fatty Acids		
Hexanoic Acid	Caproic Acid	Butterfat
Octanoic Acid	Caprylic Acid	Coconut Oil
Decanoic Acid	Capric Acid	Coconut Oil
Dodecanoic Acid	Lauric Acid	Coconut Oil
Tetradecanoic Acid	Myristic Acid	Butterfat, Coconut Oils
Hexadecanoic Acid	Palmitic Acid	Palm, Cottonseed Oils
Octadecanoic Acid	Stearic Acid	Cocoa Butter, Animal Fat
Eicsanoic Acid	Arachidic Acid	Peanut Oil
Common Unsaturated Fatty Acids		
Hexadecenoic Acid	Palmitoleic Acid	Some Fish Oils, Beef Fat
9-Octadecenoic Acid	Oleic Acid	Olive, Canola Oils
9, 12 Octadecadienoic Acid	*Linoleic Acid	Soybean, Corn Oils
9, 12, 15 Octadecatrienoic Acid	*Alpha-Linolenic Acid	Soybean, Canola Oils
5, 8, 11, 14 Eicosatetraenoic Acid	Arachidonic Acid	Lard
5, 8, 11, 14, 17 Eicosapentaenoic Acid	EPA	Some Fish Oils
Docosohexaenoic Acid	DHA	Some Fish Oils

**Essential Fatty Acids*

Saturated Fat

The *2005 Dietary Guidelines for Americans* recommend that healthy people consume less than 10 percent of calories from saturated fats daily. Meats, baked goods, and full-fat dairy products are the main sources of saturated fats in most diets. Coconut, palm, and palm kernel oils also contain saturated fats.

Unsaturated Fat

Monounsaturated and polyunsaturated fatty acids are unsaturated fats. When they replace saturated fats in the diet, they help reduce blood cholesterol levels and thus lower the risk of heart disease. The *2005 Dietary Guidelines for Americans* recommend keeping total fat intake between 20 and 35 percent of calories with most fats coming from sources of polyunsaturated and monounsaturated fatty acids such as fish, nuts, and vegetable oils.

Canola, olive, peanut, high oleic safflower and sunflower oils, and nuts are rich in monounsaturated fats. Sources of alpha-linolenic and linoleic acids, which are unsaturated fats and essential, include vegetable oils, walnuts, and flaxseed.

Cholesterol

Cholesterol is a fat-like substance that is necessary in many physiological processes such as, a component of cell membranes, the production of bile acids (which aid in food digestion), and in the production of sex hormones. An excess of cholesterol in the blood, however, can lead to deposits in the walls of blood vessels and reduce blood flow to major arteries, which can lead to a heart attack.

Contrary to popular belief, most cholesterol found in the blood is manufactured by the body itself, not derived through foods consumed in the diet. Dietary cholesterol is found only in animal foods such as egg yolks, butter, organ meats, beef, chicken, and shellfish. Vegetable oils and shortenings are cholesterol-free.

Trans Fatty Acids

Hydrogenation, developed in the early 1900s, is the process of adding hydrogen molecules directly to unsaturated fatty acids such as those found in vegetable oil. Hydrogenated oils contribute important textural and stability properties in food. The firmness and spreadability of margarines, flakiness of piecrust, creaminess of puddings, and crispiness of French fries are characteristics provided by hydrogenated oil ingredients.

During partial hydrogenation, some hydrogen atoms move from being on the same side of a double bond (*cis*) to being on the opposite side of a double bond forming a new configuration of fatty acids referred to as "*trans*," meaning "opposite." The *trans* fat content of partially hydrogenated oils may vary widely depending on the level of hydrogenation employed and the amount used in that particular product. For example, the amount of *trans* fat in a product containing lightly hydrogenated vegetable oil listed low in the ingredient list can be nutritionally insignificant. When an oil appears in the ingredient list as "hydrogenated," this means that it has been fully hydrogenated, or completely saturated with hydrogen atoms, therefore resulting as a saturated fatty acid which contains no *trans* fats.

Trans fatty acids are found naturally occurring in beef, lamb, and dairy products. However, the main sources of *trans* fats in the U.S. diet are partially hydrogenated oils, which are found in foods such as cookies, crackers, pastries, and fried foods. The National Academy of Sciences' Institute of Medicine recently concluded that *trans* fatty acids are similar to saturated fats and dietary cholesterol with regard to their effect on blood low-density lipoprotein (LDL) cholesterol. In addition, some studies suggest that increased intake of *trans* fats may lower high-density lipoprotein (HDL) cholesterol. The mean *trans* fatty acid intake in the U.S. is 2.6 percent of calories compared with 12 percent of calories from saturated fat.

Dietary Fats and Disease

Coronary Heart Disease

The main concern about excess saturated and *trans* fats in the diet centers on their potential role in raising blood cholesterol, a risk factor in the development of coronary heart disease (CHD). However, one saturated fatty acid that has received a lot of attention is stearic acid, found primarily in cocoa butter and animal fat, which is found to have a neutral effect on blood cholesterol. Further research is being conducted to determine the effect, if any, of stearic acid on other cardiovascular disease risk factors.

Physicians and other health professionals measure the level of blood cholesterol to help determine an individual's risk for CHD. According to the National Institutes of Health, less than 200 mg/dl is considered a desirable blood cholesterol level; more than 240 mg/dl is considered high total cholesterol. Scientists also have identified individual classes of blood cholesterol. Referred to as the "bad cholesterol," LDL fractions contain most of the cholesterol in the blood and are associated with cholesterol deposits on artery walls, more commonly known as plaque. Referred to as the "good cholesterol," HDL fractions are believed to carry cholesterol out of the blood and back to the liver for breakdown and excretion. Thus, having high HDL levels of cholesterol; greater than 40 mg/dL, may be as important as having low LDL levels; less than 100 mg/dL, to reduce the risk of heart disease.

In addition to diet, a wide variety of risk factors influence blood cholesterol. Risk factors beyond a person's control include age, race, and gender. But there are many risk factors that individuals can influence. These include following a healthful diet, maintaining a healthy weight,

getting adequate physical activity, controlling high blood pressure, avoiding cigarette smoking, and managing stress. For some people, heredity may be an even stronger predictor of blood cholesterol than diet.

Obesity

An individual's body weight is determined by a combination of genetic, metabolic, behavioral, environmental, cultural, and socioeconomic influences. Investigations into the cause of obesity reveal that energy intake, irrespective of macronutrient source, plays a key role in body weight. For example, as the percent of calories from fats has declined in the U.S. diet, there is no evidence that body weight is also declining. However, research has shown that a considerable decrease in the number of calories from fat will result in a small loss of body weight for normal weight and moderately obese individuals.

Cancer

In 2005, the Dietary Guidelines Advisory Committee concluded that the "evidence between total fat intake and certain cancers is suggestive but not conclusive." Data suggest that diets low in folate and calcium and high in total fat, calories, meat, and alcohol are associated with an increased risk of developing colorectal cancer and that dietary fat from animal sources may be linked to a higher risk of prostate cancer. Current research shows that dietary fat intake in general does not seem to be associated with risk of breast cancer.

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One of the questions that remains is whether associations noted between dietary fats and risk for developing cancer are correlated with the amount of fat, attributable to the type of fatty acid, or related to some other factor in food. Exploring the relationship between cancer and specific types of fats is an important area of current research.

Moderating Dietary Fat

The *2005 Dietary Guidelines for Americans* recommend a total fat intake between 20 and 35 percent of calories for adults to meet daily energy and nutritional needs while minimizing risk of chronic disease. In 2002, The Institute of Medicine (IOM) recommended that the intake of saturated fats be less than 10 percent of calories, cholesterol be less than 300 mg/day, and *trans* fatty acid consumption be as low as possible. Consumption of certain fatty acids is encouraged because of their positive health effects, which are explored in-depth in Chapter 4: Functional Foods. The U.S. Department of Agriculture's MyPyramid food guidance system recommends oils from foods such as vegetable oils, nuts, and some fish because of their healthful attributes.

According to the Continuing Survey of Food Intakes of Individuals, the median intake of total fat in the U.S. ranges from about 32 to 34 percent of total calories. The main contributors include butter, margarine, vegetable oils, egg yolks, nuts, baked goods, and visible fat on meat and poultry. Saturated fats provide approximately 11 percent of calories in adult diets, according to the National Health and Nutrition Examination Survey (NHANES) conducted between 1999 and 2000.

Types of Fat Reduction Ingredients

To help Americans moderate their dietary fat intake, advances in food science have allowed for the development of a wide variety of reduced-fat meat, dairy, and packaged food products. Fat replacers are developed to duplicate the taste and texture of fats and generally fall into three categories: carbohydrate-, protein-, or fat-based. To begin, many lower-fat products in the marketplace resulted from new processing techniques using commonplace ingredients such as water, gums, and sugars. Other fat replacers are made from proteins or fats. Each type of fat replacer ingredient provides some or all of the taste and functions of fats such as moistness in baked goods. The ingredients that are used to replace fats depend on how the food product will be eaten or prepared. For example, not all fat replacer ingredients are heat stable. As such, the type of fat replacer used in a fat-free salad dressing may not work well for a muffin mix.

Fats of the Future: Alternatives to *Trans* Fat in the Food Supply

The results of fatty acid research, both in terms of health and functionality, are likely to have practical applications for food scientists. Scientists continue to look for ways to provide *trans* fatty acid—or "*trans* fat"—alternatives to help consumers meet recommendations of the *2000 Dietary Guidelines for Americans*. *Trans* fat alternatives must provide the same functional characteristics such as texture, crispness, appearance, and stability of the product being replaced, while also remaining cost effective and abundant for use. The challenge is in bringing to consumers acceptable alternatives with these functional attributes that are lower in or free of *trans* fats, as well as lower in saturated fats. To help consumers control blood cholesterol profiles, margarines have been placed on the market with no *trans* fatty acids, and certain margarines also contain beneficial plant sterols. For more information about plant sterols, see Chapter 4 **Functional Foods**.

The evolving research behind dietary fats offers a great opportunity for nutrition scientists and food scientists to work in concert to deliver nutrition recommendations that promote health, and food products that deliver on those recommendations.

Fats on the Food Label

Historically both total fat and saturated fat were listed on the Nutrition Facts panel (NFP). As of January 1, 2006, the Food and Drug Administration (FDA) required that *trans* fat be listed below the saturated fat line in the NFP. Many food manufacturers have taken advantage of this change in the NFP to voluntarily provide information about polyunsaturated fats (PUFA) and monounsaturated fats (MUFA) contained in the product. Consumers can use this information, along with both health claims that meet significant scientific agreement (SSA) and those that are "qualified," on food packaging to make more informed choices about products before purchase.

Health claims are an example of a label education tool regulated by the Food and Drug Administration (FDA). They appear on food packages to aid the consumer with additional nutrition information about health effects of that specific food. These claims display the strength of scientific evidence representing the relationship between a food component and a disease or health-related condition. Health claims have historically focused on foods low in fat, saturated fats, and cholesterol. Health claim declarations include references to some cancers and coronary heart disease risk.

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"Qualified" health claims, which characterize the level of scientific evidence linking a specific food component or food to a disease or health-related condition, are more common as additional science becomes available on individual fatty acids and their impact on health. The FDA, after evaluation of research on two fatty acids, released two qualified health claims for EPA/DHA and olive oil to acknowledge their possible beneficial effects of reducing the risk of coronary heart disease. A qualified health claim relating to coronary heart disease risk was also approved for canola oil, based on its unsaturated fat content. Currently, other fatty acids like eicosapentaenoic acid (EPA), docosahexaenoic acid (DHA), alpha-linolenic acid, linoleic acid, stearic acid, and a multitude of other fatty acids are beginning to be studied further to determine their impact on health.

BACKGROUNDER

Dietary Fats & Fat Replacers

Balancing Calories

Ultimately, weight management is dependent on balancing the number of calories consumed with the number of calories expended. The specific question for researchers is whether consumers compensate—or even over-compensate—for calories or fats when consuming nutrient-modified foods. Currently, research has moved into focusing on how our body recognizes signals of fullness. It is unclear whether the energy-density or the proportion of nutrients such as fat, protein, carbohydrates, fiber, and water that are present in a given meal sends the signal of fullness to the body.

Generally the research finds that individuals who are good at regulating their calorie intake over time will continue to do so when consuming reduced-fat foods. This results in the same number of total calories with a smaller percentage coming from fats. In contrast, those individuals who are concerned with their body weight may be more likely to reduce caloric intake using fat-modified foods, but may still over consume calories. Health professionals can play a key role in helping consumers understand how to achieve dietary recommendations for fat intake within a well-balanced diet that features the recommended amounts of a variety of foods.

Over time, consumers continue to become more knowledgeable about dietary fats and fatty acids, but changes in behavior do not appear to be undertaken.

Consumer Knowledge: Yesterday and Today

Extensive IFIC consumer research has shown a knowledge-behavior disconnect in what consumers "know" about diet and nutrition, and what they "do." Over time, consumers continue to become more knowledgeable about dietary fats and fatty acids, but changes in behavior do not appear to be undertaken. This disconnect may be a result of consumers feeling bombarded with information from a variety of sources such as the Internet, food labels, friends, family, television, the government, and a host of others. Many consumers find it difficult to separate valid advice from fad diet recommendations.

This research also showed that consumers have a general sense that fat is needed by the body to function properly, but that too much can pose serious health risks. In addition, it showed that consumers think about fat in a polarized manner. For example, they feel that fats make food taste good, but believe it should be restricted or eliminated completely from the diet. Consumers associate dietary fats more with foods that contain them, rather than the specific fatty acid. Whether fats promote health benefits is still unclear to many consumers, but they are open to messages on how fats promote health in the context of a balanced lifestyle.

Finally, consumer research revealed that consumers do not know how to balance a healthful lifestyle and the foods they most enjoy. Most feel that in order to have more healthful eating habits they need to restrict their favorite foods. Additional IFIC research found that consumers want very personalized dietary information that is specific to their lifestyle. Therefore, it is important for consumers to receive dietary messages that are personalized and realistic in order for them to incorporate a balance of dietary fats into a diet plan that is meant for health or weight loss.

Historically, consumers have expressed a desire for foods lower in calories and fat. But moderation in total fat and making informed choices in dietary fat consumption such as trimming visible fat from meats, removing skin from poultry, and choosing fat-free or low-fat milk, is only one aspect of good nutrition. Balance, variety, and moderate intake of all foods are prudent approaches for the general population. Moreover, a well-balanced diet in combination with plenty of exercise, maintaining proper weight, and controlling conditions such as hypertension or diabetes are the best approaches to living a more healthful lifestyle.

For more information about IFIC consumer research, see: http://www.ific.org/research.